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(54) BARGE FOR CARRYING LIQUEFIED NATURAL GAS LNG TANKER TRUCKS

(57) The invention solves problems relating to LNG supply in remote areas such as islands lacking port areas adapted for supplying LNG, the invention consisting of a barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations, comprising at least one self-propelled liquefied natural gas LNG tanker truck located on the deck of the barge, a connection module for connecting the barge to the LNG supply from a supply source, at least one LNG loading module for loading LNG into tanker trucks, at least one LNG distribution module linking the connection module for connecting the barge to the LNG supply and the LNG loading module for loading LNG into tanker trucks, tanker truck barge access means and tanker truck barge exit means.

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Description

Technical Field of the Invention

[0001] The invention is comprised in the technical field of natural gas transport and logistics systems, more specifically in the transport of liquefied natural gas LNG from gas fields or gas-producing countries to end customers or consumers, when said consumers are located in locations that are hard to access by sea.

[0002] The system for transport and distribution of the invention is also comprised in maritime means used for transporting and distributing liquefied natural gas to these end customers or consumers which may be located close to or away from the coast, but in any case scattered in a large area consisting of a number of islands between which logistics transport can be carried out by sea.

Prior State of the Art

[0003] Liquefied natural gas LNG is transported from the natural gas-producing countries to consuming countries using large ships referred to as methane or gas carriers. In these carriers, the gas must be kept at a temperature of -161 °C for long distances, the natural gas being transported in liquid state at a pressure higher than atmospheric pressure. Large methane or gas carriers have a load capacity between 30,000 and 266,000 m^3.

[0004] LNG is transported in tanks that withstand these low temperatures, where it is kept at the temperature at which it was loaded, i.e., at about -161°C, throughout the entire voyage, but depending on its temperature and pressure, a part of the liquid evaporates due to boiling. The evaporated gas is often used to propel the carrier, either by consuming it in boilers or using it in engines that use the gas as fuel.

[0005] Often when unloading the transported gas in the port, a small amount of load is left in the tanks and it will keep the tanks cold as it gradually evaporates during the journey, where only a short, more intense, final cooling is required before loading the LNG again. This is achieved with that same remaining load, extracting it from the tanks, which load cools the tanks to the temperature required for loading as it evaporates.

[0006] These large methane or gas carriers require ports with a large draft and furthermore, due to the load they transport, they usually load and unload liquefied natural gas in loading terminals away from ports that are connected to onshore areas through pipes.

[0007] There are two systems for transporting LNG to end customers or consumers: the first one in which the piped gas reaches a large number of consumers, such as homes, industries, shopping centers, etc., from regasification plants or directly from gas pipelines connected to gas extraction plants. However, in distribution centers that are located far away from large consumption points or isolated from the network of gas pipelines, it is not profitable to invest in piped supply networks, so LNG storage tanks that are generally receive a supply from tanker trucks which regularly fill up such tanks are used. The invention herein described aims to provide service to customers of this type.

[0008] Patent application PCT WO2016/036690 relating to a system for marine transportation of cryogenic hydrocarbons is known, i.e., it relates to a small-scale transportation of liquefied natural gas, a system which includes a plurality of barges with liquefied gas-containing tanks having a capacity of 25,000 m^3 or less, and a semisubmersible transfer ship, these barges cooperating with the semisubmersible ship for distributing gas to onshore installations where the liquefied gas is unloaded and regasified. This system makes it easier to supply natural gas to coastal areas with a small depth, making it suitable for use under these circumstances; however, a port infrastructure for storing liquefied natural gas, and even a regasification plant from which gas is distributed through pipes to the end customer or consumer, is still required.

[0009] The problem that may arise occurs when the end customers or consumers are located, for example, in widely scattered archipelagos or islands where building those port installations in each and every one of those places is not profitable as it is not worthwhile economically speaking, making it impossible to be able to supply liquefied natural gas to a very large group of customers that are scattered throughout those islands.

[0010] A second problem relating to consumers of this type is that even though they have port installations for discharging LNG, they do not posses large LNG tanker trucks, and lack pipes which distribute LNG to consumers. An LNG transport and distribution system that does not depend on each specific island or area where supply is to be provided, i.e., a completely autonomous system, is therefore advisable.

Description of the Invention

[0011] The object of the invention consisting of a barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations has been developed to solve problems relating to LNG supply in remote areas such as islands lacking port areas adapted for supplying LNG and for supplying LNG from these port areas to the rest of the island by means of trucks or pipelines, the invention comprising:

- at least one self-propelled liquefied natural gas LNG tanker truck located on the deck of the barge
- a connection module for connecting the barge to the LNG supply from a supply source
- at least one LNG loading module for loading LNG into tanker trucks
- at least one LNG distribution module linking the connection module for connecting the barge to the LNG supply and the LNG loading module for loading LNG into tanker trucks

- tanker truck barge access means
- tanker truck barge exit means.

[0012] Tanker truck access means and exit means can be the same or the access means are located at the end opposite the tanker truck barge exit means, so tanker trucks having small dimensions that can be maneuvered on the deck of the barge and depart through the access through which they entered can be used, or when tanker trucks having larger dimensions are used, whereby it is hard to maneuver same as a lot of space is required, the most suitable arrangement would be for the trucks to enter through one end of the carrier and depart through the opposite end according to the orientation of the tractor units of the tanker trucks.

[0013] The tanker truck access and exit means consist of ramps for the passage of the tanker trucks by rolling as it will make it easier for the trucks to get on and off the deck of the barge, each tanker truck being located at its loading position for loading LNG.

[0014] The barge with empty tanker trucks will approach a small LNG carrier which functions as a mothership, and the barge is connected to the small LNG carrier through the connection module for connecting the barge to the LNG supply, which comprises:

- at least one connection for an LNG line through which the barge receives a supply of said LNG which is loaded into tanker trucks located on the deck of the barge
- at least one nitrogen connection filling up the tanks, pipes and hoses with nitrogen, replacing the oxygen of the air with inert nitrogen gas
- at least one gas unloading connection for unloading gases originating from vaporized natural gas which can be liquefied again or can be used, if they have already been gasified, for powering the engines or turbines of the barge, or can be burned.
- loading hoses between the barge and the small LNG carrier which can be used for transferring LNG, nitrogen and gases originating from LNG vaporization.
- at least one instrumentation and control module for the transferred LNG, nitrogen and gas unloading operation performed, monitoring and controlling the entire unloading process.

[0015] This barge has no LNG tanks for supplying fuel to a third party, but rather it is a means for transferring and distributing LNG from the small LNG carrier and the tanker trucks arranged on the deck thereof.

[0016] The deck of the barge is divided into one or more tanker truck loading positions since the space of the deck can be optimized for loading multiple tanker trucks. At each tanker truck loading position there is at least one LNG loading module for loading LNG into the tanker trucks. These loading modules comprise:

- a loading unit for loading LNG into the tanker trucks
- an unloading unit for unloading gases from the tanker trucks, extracting the vaporized LNG
- control and safety valves assuring safe filling of the tanks
- an instrumentation, measurement and control system for the process of loading LNG into the tanks of the trucks
- loading hoses and connection/disconnection systems between hoses and tanks of the trucks

[0017] The deck of the barge is used to hold multiple loading positions where the LNG tanker trucks are located, and where these loading positions have loading modules for loading LNG into the tanker trucks, adapted to the size of the tanker trucks and the dimensions of the barge, so the barge therefore has at least two loading modules aligned with the axis of the vessel and/or barge, while at the same time it has at least two loading modules aligned on an axis perpendicular to the axis of the vessel and/or barge, where configurations with four, six, nine or more tanker truck loading positions, adapted to the size of the barge, can be adopted.

[0018] To make the barge reversible and to allow the trucks to enter and exit through both ends of the vessel, a configuration must be used in which the number of loading modules aligned with the axis of the vessel is equal to the number of tanker truck loading positions plus one, making the vessel reversible both in terms of tanker truck loading and unloading, given that the location of the load openings in the tanker trucks which are not in the midpoint thereof must be envisaged.

[0019] A final detail to be taken into account relates to the conduit for venting gases originating from LNG vaporization in the tanker trucks, which in a preferred embodiment of the invention is extracted from the barge for liquefaction outside said barge, although this does not rule out the possibility of liquefying same in the barge itself or using same for barge engine consumption, or even burning same in the gas flare.

[0020] The barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations is completed with the inclusion of systems that are essential for driving the vessel and handling the products transported therein

- emergency systems for the rapid disconnection of aerial hoses connecting the barge and the small LNG carrier
- emergency systems interrupting the loading operation in the event of an irregular incident or LNG leakage, preventing damage due to hazardous, uncontrolled LNG leakages
- fire detection and extinguishing systems that are essential for the treatment and handling of hazardous products of this type, as well as
- accidental LNG spillage management system

Brief Description of the Drawings

[0021] For the purpose of helping to better understand the features of the invention according to a preferred practical thereof embodiment, a series of drawings is attached as an integral part of said description, in which the following is depicted with an illustrative and non-limiting character:

Figures 1 to 3 depict, respectively, a plan view, an elevational front view, and an elevational side view of a barge for carrying tanker trucks, like the one proposed by the invention.

Figure 4 depicts a schematic top perspective view of a barge like the one of the invention with tanker trucks being loaded on the deck of the vessel.

Figures 5 and 6 depict several schematic plan views of the process of loading and unloading the trucks on/from the deck of the barge.

Figure 7 depicts a diagram showing the pipelines existing in the barge.

Detailed Description of a Preferred Embodiment of the Invention

[0022] Figures 1 to 3 depict, respectively, a plan view, an elevational front view, and an elevational side view of a barge (1) for carrying tanker trucks (3) like the one proposed by the invention, in which said barge has a flat surface, i.e., the deck (2), accessible both from the bow access (4) and from the stern access (5), which bow and stern are irrelevant in this case as the vessel can sail regardless, given that it has engines (6) on both sides, and maneuverability can therefore be increased.

[0023] To make it easier for the tanker trucks (3) to access the deck (2) of the barge, a bow ramp (7) and a stern ramp (8) are provided, making it easier for the tanker trucks (3) to get on and off by rolling.

[0024] It can be seen in these drawings that said barge has nine tanker truck loading positions (9) where the trucks are located at an angle in threes, covering the deck of the barge. In the elevational side view of the barge shown in Figure 3, three tanker trucks (3) can be seen aligned with the loading modules (10) of the tanker trucks.

[0025] Figure 4 depicts a schematic top perspective view of a barge (1) like the one of the invention with tanker trucks (3) being loaded on the deck (2) of the vessel. This depiction allows seeing how a tanker truck (3) accesses the bow access (4) through the bow ramp (7), and how another tanker truck (3) is already at its loading position (9) so that the tanker truck can be filled with LNG from the loading module (10), an operation which is carried out when the barge approaches the small LNG carrier and is connected thereto.

[0026] It can be seen in this same depiction how once the tanker trucks (3) are filled with LNG, the barge will move to a port, positioning itself such that the stern ramp (8) is deployed, the tanker trucks exiting in the direction of travel through the stern access (5).

[0027] It is observed in this same Figure 4 that while there are nine loading positions (9) on the deck of the barge, there are, however, twelve loading modules (10), and that is due to the reversibility of the barge which may allow accessing or exiting the barge both from bow and stern, so an aligned loading module configuration must be envisaged in a number such that the number defining the loading modules to be aligned longitudinally with the axis of the barge (1) is the number of loading positions plus one. In this case, since there are three parallel alignments of loading positions, there will be three more loading modules than there are number of loading positions, as seen in the mentioned drawing.

[0028] Figures 5 and 6 depict schematic plan views of the process of loading and unloading the trucks on/from the deck of the barge. Figure 6 shows, by means of arrows, the flow of empty trucks entering the barge (1) through the stern access (5) and how each tanker truck is located at its loading position (9) for connection to the loading modules (10). Upon reaching the port, the barge (1) positions itself such that its bow and bow access (4) face the dock of the port, so that the trucks follow a flow without performing any maneuver on the barge (1), i.e., if the tanker trucks enter through the bow, they must exit the barge through the stern, the need to maneuver the tanker trucks on the deck of the barge (2) thereby being prevented.

[0029] Figure 7 depicts a diagram of the pipelines existing in the barge (2) and how they are connected to the small LNG carrier (11) through the connection module of the barge (12). This same drawing shows the twelve loading modules (10), each of the which will have

- a loading unit (13) for loading LNG into the tanker trucks (3)
- an unloading unit (14) for unloading gases from the tanker trucks (3), extracting the vaporized LNG
- control and safety valves assuring safe filling of the tanks
- an instrumentation, measurement and control system for the process of loading LNG into the tanks of the trucks
- loading hoses and connection/disconnection systems between hoses and tanks of the trucks

[0030] While the drawing does not show the last three elements, it does show in detail the LNG distribution module (17) in the barge, which is basically made up of LNG feed lines (15) and LNG vapor lines (16) that are connected to the small LNG carrier (11).

Claims

1. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations, comprising:

- at least one liquefied natural gas LNG tanker truck (3) located on the deck (2) of the barge (1),
- a connection module (12) for connecting the barge to the LNG supply from a supply source,
- at least one loading module (10) for loading LNG into the tanker trucks (3),
- at least one LNG distribution module (17) linking the connection module (12) for connecting the barge (1) to the LNG supply and the loading module (10) for loading LNG into the tanker trucks,
- tanker truck barge access means,
- tanker truck barge exit means.

2. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claim 1, **characterized in that** tanker truck access means and exit means are the same.

3. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claim 1, **characterized in that** the access means are located at the end opposite the tanker truck barge exit means.

4. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1 to 3, **characterized in that** the tanker truck access and exit means consist of ramps (7), (8) for the passage of the tanker trucks (3) by rolling.

5. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claim 1, **characterized in that** the connection module (12) for connecting the barge to the LNG supply comprises:

- at least one connection for an LNG line,
- at least one nitrogen connection,
- at least one gas unloading connection,
- loading hoses between the barge and the small LNG carrier,
- at least one instrumentation and control module for the transferred LNG, nitrogen and gas unloading operation performed.

6. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claim 1, **characterized in that** each loading module (10) for loading LNG into the tanker trucks (3) comprises:

- a loading unit (13) for loading LNG into the tanker trucks,
- an unloading unit (14) for unloading gases from the tanker trucks (3)
- control and safety valves,
- an instrumentation, measurement and control system for the process of loading LNG into the tanks of the trucks,
- loading hoses and connection/disconnection systems between hoses and tanks of the trucks.

7. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5 and 6, **characterized in that** it has multiple loading positions (9) where the LNG tanker trucks (3) are located and where these loading positions (9) have loading modules (10) for loading LNG into the tanker trucks (3), adapted to the size of the tanker trucks and the dimensions of the barge.

8. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5, 6 and 7, **characterized in that** the barge (1) has at least two loading modules (10) aligned with the axis of the vessel.

9. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5, 6 and 7, **characterized in that** the barge (1) has at least two loading modules (10) aligned on an axis perpendicular to the axis of the vessel.

10. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5, 6, 7, 8 and 9, **characterized in that** the number of loading modules (10) aligned with the axis of the vessel is equal to the number of loading positions (9) of tanker trucks (3) plus one, making the vessel reversible both in terms of tanker truck loading and unloading.

11. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5 and 6, **characterized in that** the conduit for venting gases originating from LNG vaporization in the tanker trucks is extracted from the barge for being managed outside said barge.

12. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5 and 6, **characterized in that** the conduit for venting gases originating from LNG vaporization in the tanker trucks is liquefied in the barge itself.

13. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1, 5 and 6, **characterized in that** the conduit for venting gases originating from

LNG vaporization in the tanker trucks, to be consumed by the engines thereof or burned in the gas flare.

14. Barge for carrying liquefied natural gas LNG tanker trucks and the distribution thereof to different locations according to claims 1 to 13, **characterized in that** it further comprises:

- emergency systems for the rapid disconnection of aerial hoses connecting the barge and the small LNG carrier,
- emergency systems interrupting the operation of loading LNG into the tanker trucks in the event of an irregular incident or leakage ,
- fire detection and extinguishing systems,
- accidental LNG spillage management system.

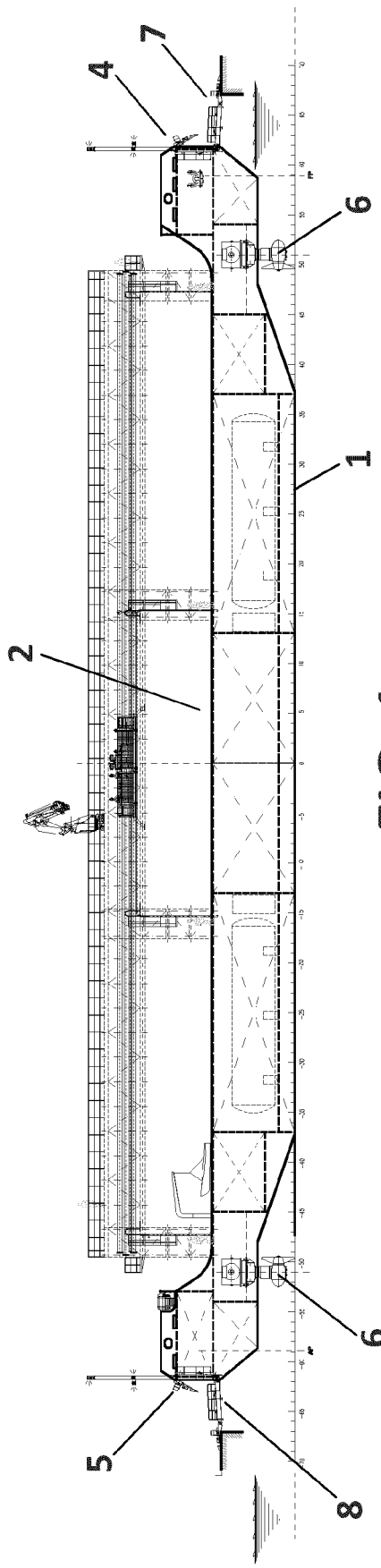

FIG. 1

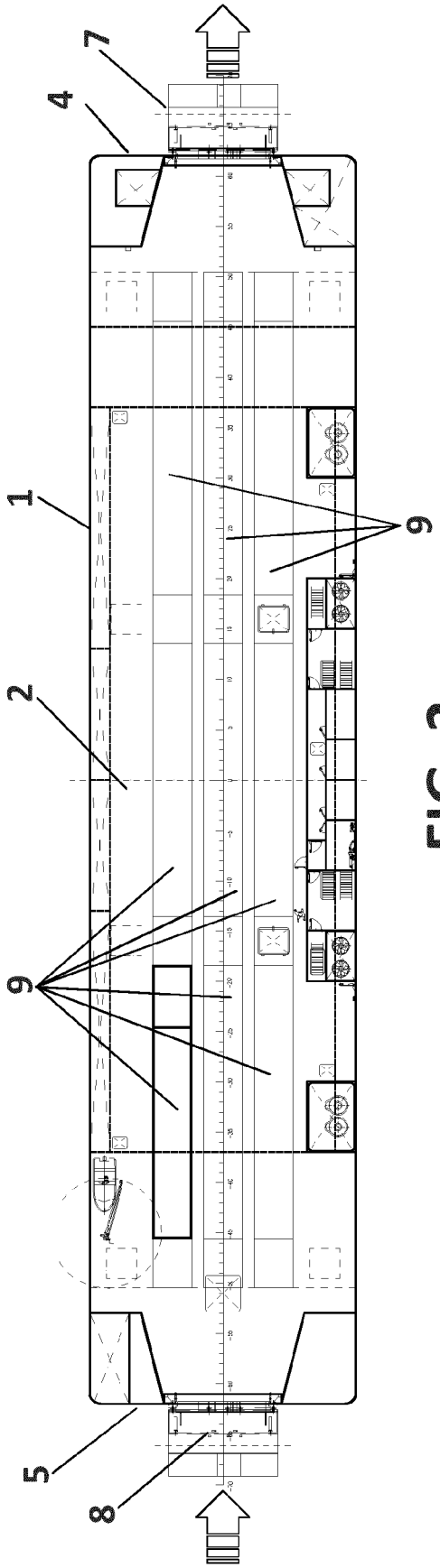

FIG. 2

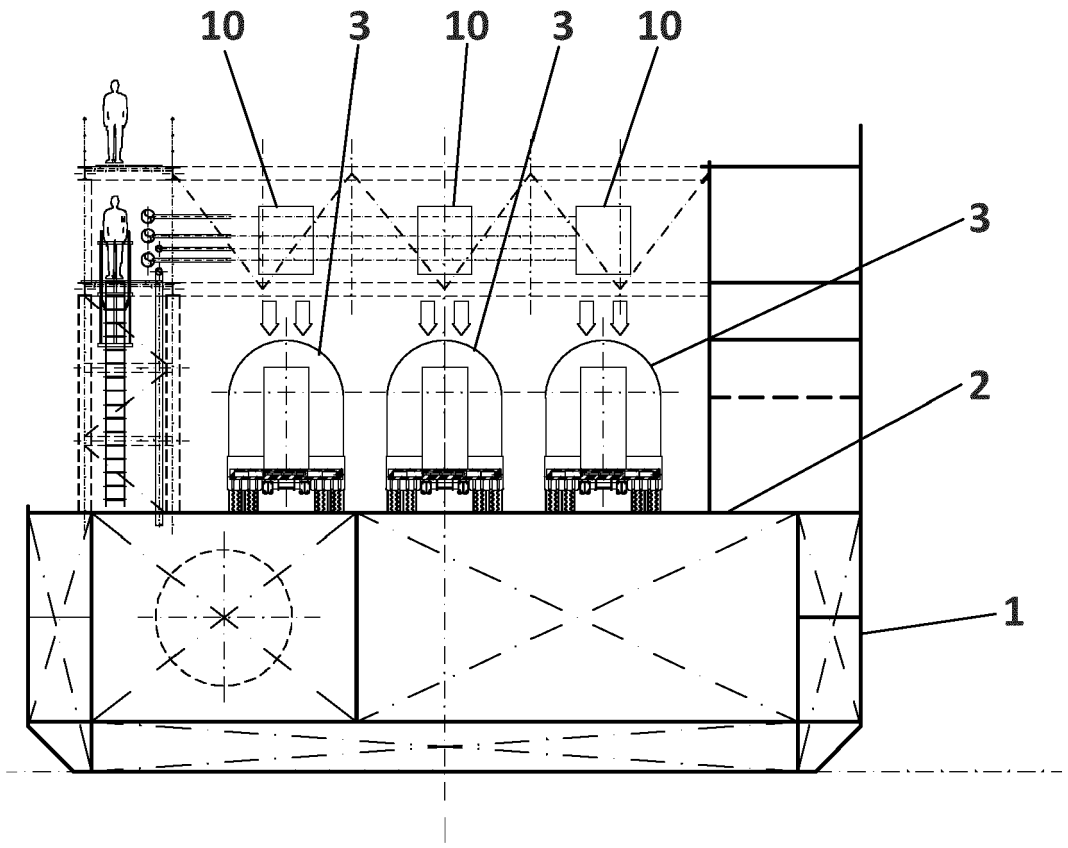

FIG. 3

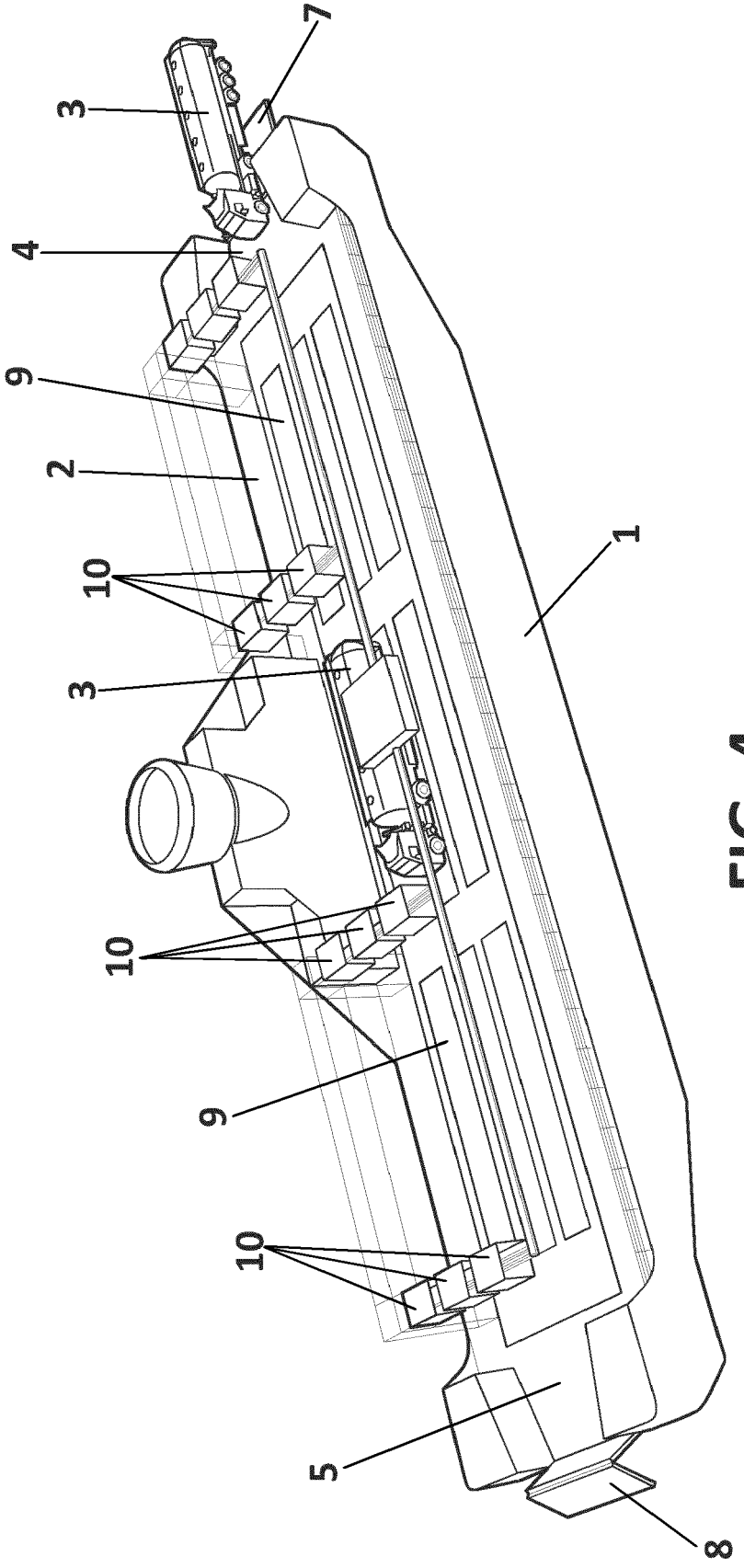

FIG. 4

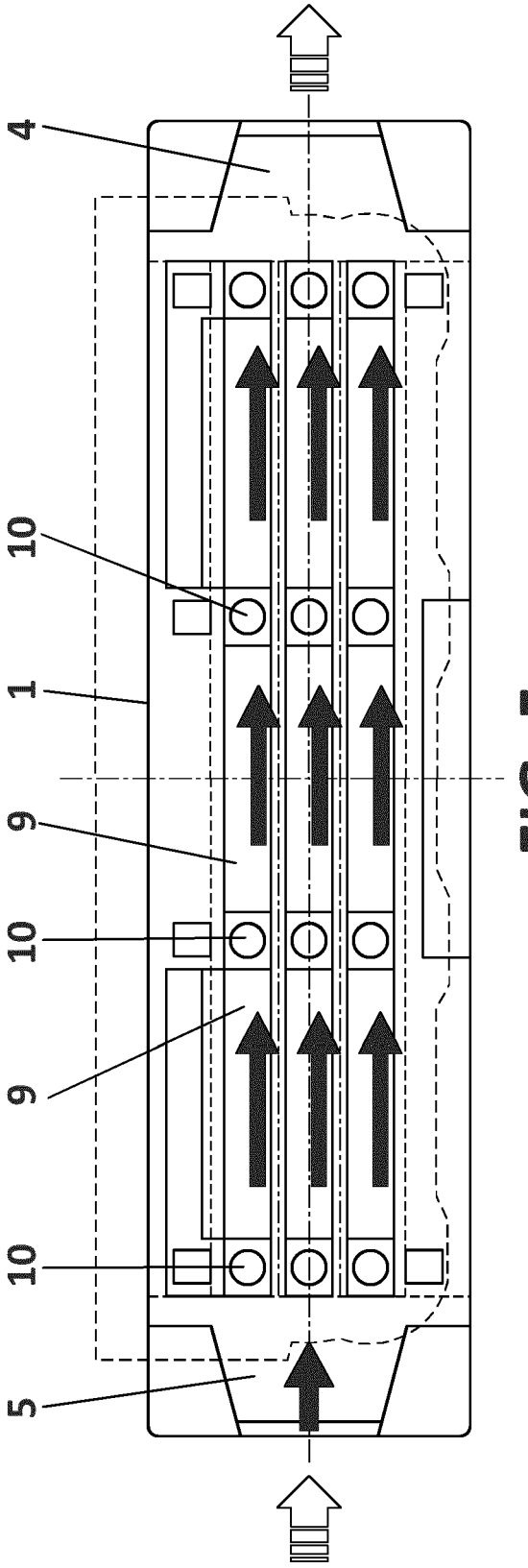

FIG. 5

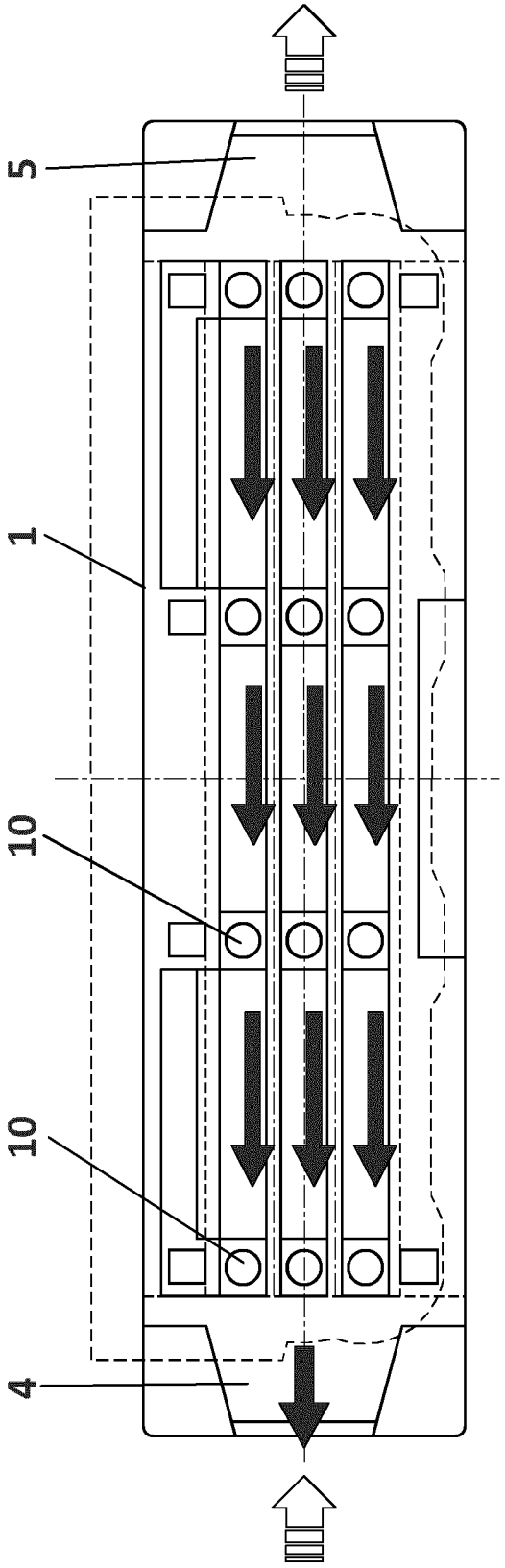

FIG. 6

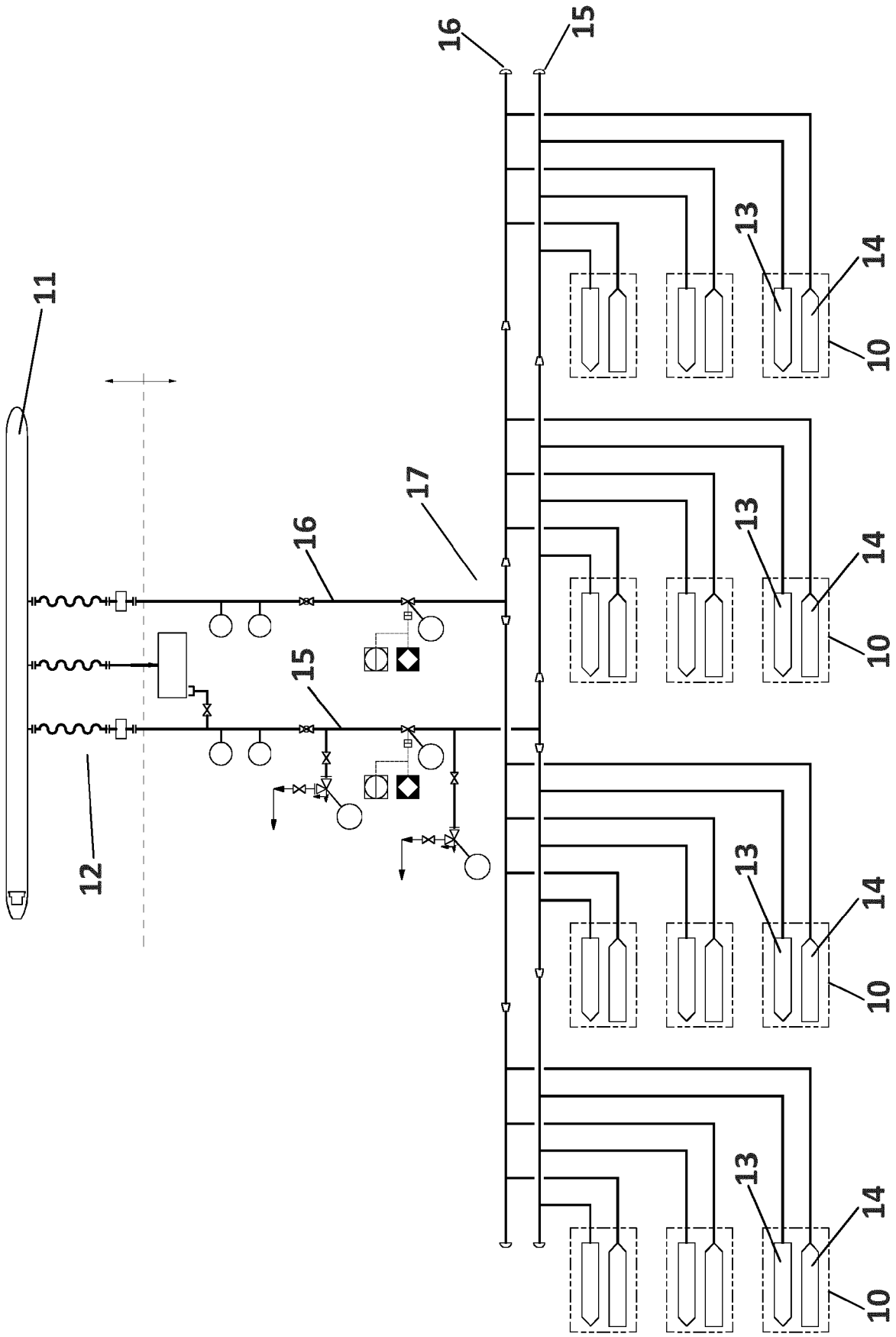

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 18 38 2503

DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 2 597 025 A1 (STX FRANCE SA [FR]) 29 May 2013 (2013-05-29) * paragraph [0010]; figures *	1-14	INV. B63B35/28 B63B25/12 B63B27/00 B63B27/24 F25J1/02 B63B25/00 B63B27/34 B63B25/14
A	JP 2006 046460 A (TOKYO GAS CO LTD) 16 February 2006 (2006-02-16) * paragraph [0008] * * paragraph [0018] * * paragraph [0021] * * figure 1 *	1-14	
A	WO 2010/042073 A1 (KEPPEL OFFSHORE & MARINE TECHN [SG]; FOO KOK SENG [SG]; YIP HEE YAN [S) 15 April 2010 (2010-04-15) * page 8, line 31 - page 9, line 8 * * page 12, line 30 - page 13, line 4 * * page 13, line 22 - line 30 * * figure 6 *	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

B63B
F25J
F17C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31 October 2018	Schmitter, Thierry

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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